UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 1997/98

FEBRUARI 1998

REG 262 - Rekabentuk Struktur

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMABELAS** muka surat yang tercetak sebelum anda memulakan peperiksaan ini.

Jawab **EMPAT** soalan sahaja.

1. (a) Apakah peranan model dalam rekabentuk struktur?

(5 markah)

(b) Senarai dan bincangkan bahan-bahan yang lazim digunakan sebagai anggota struktur.

(10 markah)

(c) Bincangkan bagaimana rasuk konkrit tetulang selalunya gagal dan lakarkan jenis-jenis tanda keretakan yang akan ditunjukkan jika berlaku bebanan yang berlebihan.

(10 markah)

2. (a) Jelaskan perbezaan M_{mak} dan M_u dalam rekabentuk konkrit tetulang.

(5 markah)

(b) Rujuk **Rajah 2.1** yang menunjukkan gambarajah daya ricih dan gambarajah momen lentur sebuah rasuk selanjar konkrit tetulang.

Diberi: $f_{cu} = 25\ N/mm^2$

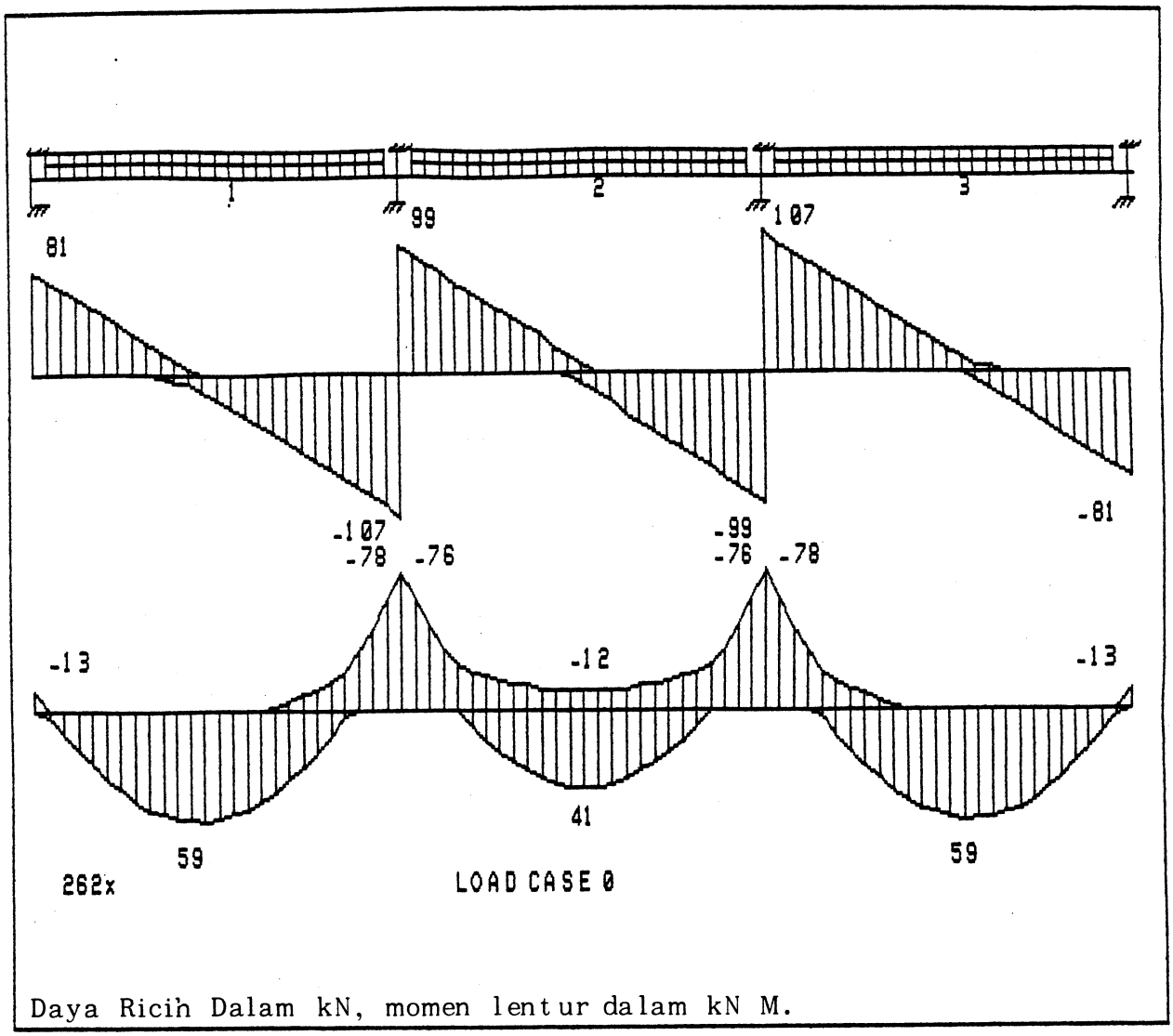
$f_y = 410\ N/mm^2$

$b = 300mm$

Tentukan tetulang utama (saiz dan jumlah) yang diperlukan di tengah rentang dan pada penyokong.

(20 markah)

RAJAH 2.1



Daya Ricih Dalam kN, momen lentur dalam kN M.

3. (a) Bincangkan **TIGA** jenis beban asas yang berkaitan dengan rekabentuk struktur.

(10 markah)

(b) **Gambarajah 3.1** menunjukkan pelan susunatur lantai sebuah bangunan. Lantai tersebut perlu direkabentuk supaya dapat menanggung beban kenaan sebanyak 4 kN/m^2

Anggapkan: Ketebalan lantai = 150mm

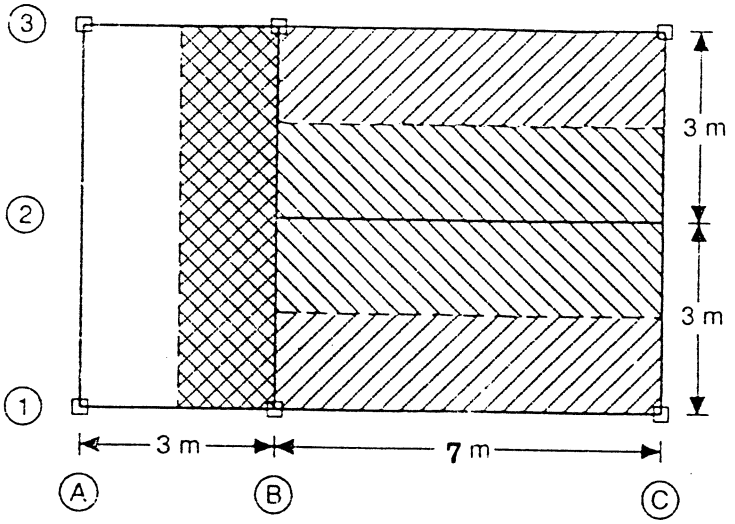
Berat rasuk = 70 kg/m

Beban Mati Konkrit = $24kN/m^3$

Graviti = $10\ m/s^2$

N = $kg.m/s^2$

Tentukan beban rekabentuk untuk rasuk B1 - C1 dan B2 - C2.

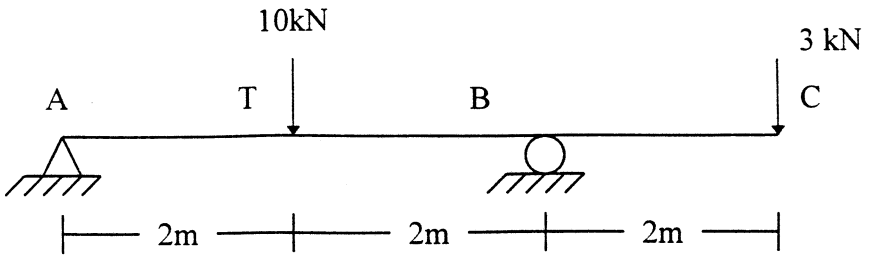


Gambarajah 3.1

(15 markah)

4. Untuk sistem rasuk dalam **Rajah 4** kirakan nilai pesongan dititik T dan putaran rasuk dititik C.

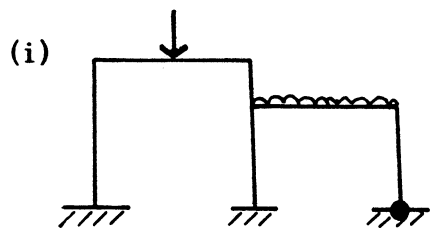
Nilai E = 200 kN/m^2; I = 150 x 10^6 mm^4

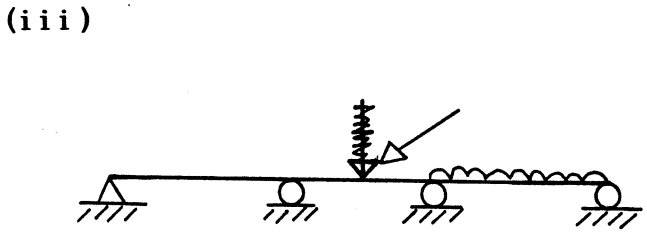


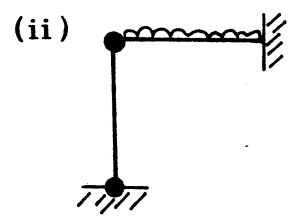
Rajah 4

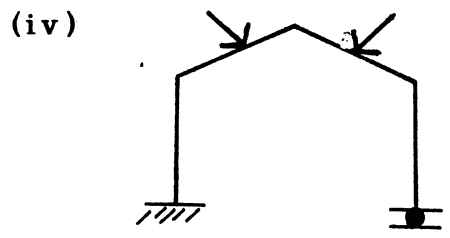
(25 markah)

5. (a) Tentukan Darjah Ketidak boleh tentuan kesemua struktur-struktur di dalam **Rajah 5**.1.



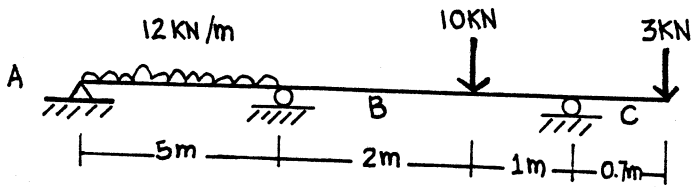






Rajah 5.1

(b) Untuk sistem rasuk **Rajah 5.2**, dapatkan kesemua tindakbalas di A, B & C dan serta lukisan gambarajah daya ricih dan momen lentur untuk keseluruhan rasuk.



RAJAH 5.2

(25 markah)

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BANTUAN REKABENTUK

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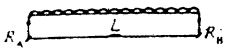
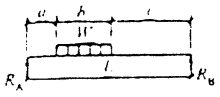
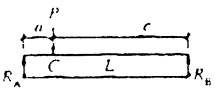
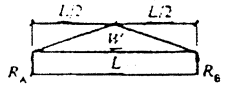
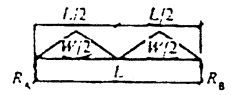
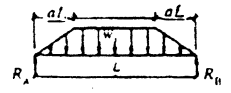
Jadual 3.4 Jadual untuk menentukan daya ricih, momen lentur, dan pesongan maksimum

Jenis bebanan pada rasuk	Tindak balas R_A dan R_B	Momen lentur maksimum	Pesongan/pesongan maksimum rasuk
Jumlah beban = W 	$R_A = R_B = W/2$	$M_{maks} = \frac{WL}{8}$	$\delta_{maks} = \frac{5WL^3}{384EI}$
	$r = \frac{0.5b + c}{L}$ $R_A = Wr$ $R_B = W(1 - r)$	$M_{maks} = Wr(a + 0.5rb)$ berlaku pada jarak $d = a + rb$ dari A	$d = a + rb$ $e = rb\left\{L^2 - c^2 - cb - \frac{b^2}{2}\right\}$ $a \le x \le (a + b)$ $\delta_x = \frac{W}{24EIb}[x^4 - 4dx^3 + 6a^2x^2 + 4(e - a^3)x + a^4]$
	$R_A = \frac{Pb}{L}$ $R_B = \frac{Pa}{L}$	$M_{maks} = \frac{PL}{4}$ apabila $a = b$ $M_{maks} = \frac{Pab}{L}$ berlaku di titik C	$\delta_{maks} = \frac{PL^3}{48EI}$ apabila $a = b$ $\delta_{maks} = \frac{Pab(L + b)}{27EIL}[3a(L + b)]^{1/2}$ apabila $a > b$ dan berlaku pada jarak $x = \frac{(aL + b)^{1/2}}{3}$ $\delta_x = \frac{Pa^2b^2}{3EIL}$
	$R_A = R_B = W/2$	$M_{maks} = \frac{WL}{6}$	$\delta_{maks} = \frac{WL^3}{60EIL}$
	$R_A = R_B = W/2$	$M_{maks} = \frac{WL}{8}$	$\delta_{maks} = \frac{WL^3}{73EI}$ berlaku di tengah rentang
	$R_A = R_B = W/2$	$M_{maks} = \left(\frac{3 - 4a^2}{24(1 - a)}\right)WL$	$\delta_{maks} = \frac{(4a^2 - 5)^2WL^3}{1920(1 - a)EI}$ berlaku di tengah rentang

Jadual 9.6 Luas tetulang keluli (untuk rasuk)

Bilangan bar	Luas keratan rentas untuk bar bernombor tertentu							
	6 mm	8 mm	10 mm	12 mm	16 mm	20 mm	25 mm	32 mm
1	28.3	50.3	78.5	113	201	314	491	804
2	56	100	157	226	402	628	981	1608
3	84	150	235	339	603	942	1472	2412
4	113	201	314	452	804	1256	1963	3216
5	141	251	392	565	1005	1571	2454	4021
6	169	301	471	678	1206	1885	2945	2825
7	198	352	549	791	1407	2199	3436	5629
8	226	402	628	904	1603	2513	3927	6433
9	254	452	706	1017	1809	2827	4418	7237
10	283	503	785	1131	2011	3142	4909	8042

Jadual 9.7 Luas tetulang keluli (untuk papak)

Guris-pusat bar	Luas keratan rentas per meter lebar pada jarak yang berbeza (mm2)						
	Jarak antara bar						
	75 mm	100 mm	125 mm	150 mm	175 mm	200 mm	300 mm
6 mm	377	283	226	188	161	141	94
8 mm	670	503	402	335	287	251	167
10 mm	1046	785	628	523	448	392	261
12 mm	1508	1131	904	754	646	565	377
16 mm	2681	2011	1608	1340	1149	1005	670
20 mm	4189	3142	2513	2094	1795	1571	1047

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Table 3.8 Form and area of shear reinforcement in beams

Value of v (N/mm^2)	Form of shear reinforcement to be provided	Area of shear reinforcement to be provided
Less than 0.5 v_c throughout the beam	See note 1	
$0.5\,v_c < v < (v_c + 0.4)$	Minimum links for whole length of beam	$A_{sv} \geq 0.4\,b_v s_v / 0.87\,f_{yv}$ (see note 2)
$(v_c + 0.4) < v < 0.8\sqrt{f_{cu}}$ or 5 N/mm^2	Links or links combined with bent-up bars. Not more than 50 % of the shear resistance provided by the steel may be in the form of bent-up bars (see note 3)	*Where links only provided:* $A_{sv} \geq b_v s_v (v - v_c)/0.87\,f_{yv}$ *Where links and bent-up bars provided:* see 3.4.5.6

NOTE 1. While minimum links should be provided in all beams of structural importance, it will be satisfactory to omit them in members of minor structural importance such as lintels or where the maximum design shear stress is less than half v_c.

NOTE 2. Minimum links provide a design shear resistance of 0.4 N/mm^2.

NOTE 3. See 3.4.5.5 for guidance on spacing of links and bent-up bars.

Table 3.9 Values of v_c, design concrete shear stress

$\frac{100\,A_s}{b_v d}$	Effective depth (in mm)							
	125	150	175	200	225	250	300	≥ 400
	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2
≤ 0.15	0.45	0.43	0.41	0.40	0.39	0.38	0.36	0.34
0.25	0.53	0.51	0.49	0.47	0.46	0.45	0.43	0.40
0.50	0.67	0.64	0.62	0.60	0.58	0.56	0.54	0.50
0.75	0.77	0.73	0.71	0.68	0.66	0.65	0.62	0.57
1.00	0.84	0.81	0.78	0.75	0.73	0.71	0.68	0.63
1.50	0.97	0.92	0.89	0.86	0.83	0.81	0.78	0.72
2.00	1.06	1.02	0.98	0.95	0.92	0.89	0.86	0.80
≥ 3.00	1.22	1.16	1.12	1.08	1.05	1.02	0.98	0.91

NOTE 1. Allowance has been made in these figures for a γ_m of 1.25.

NOTE 2. The values in the table are derived from the expression:

$$0.79\,(100\,A_s/(b_v d))^{1/3}\,(400/d)^{1/4}/\gamma_m$$

where

$\frac{100\,A_s}{b_v d}$ should not be taken as greater than 3;

$\frac{400}{d}$ should not be taken as less than 1.

For characteristic concrete strengths greater than 25 N/mm^2, the values in table 3.9 may be multiplied by $(f_{cu}/25)^{1/3}$. The value of f_{cu} should not be taken as greater than 40.

Table 3.10 Values of A_{sv}/sv

Diameter of links (mm)	Spacing of links (mm)										
	85	90	100	125	150	175	200	225	250	275	300
8	1.183	1.118	1.006	0.805	0.671	0.575	0.503	0.447	0.402	0.336	0.335
10	1.847	1.744	1.57	1.256	1.047	0.897	0.785	0.698	0.628	0.571	0.523
12	2.659	2.511	2.26	1.808	1.507	1.291	1.13	1.004	0.904	0.822	0.753
16	4.729	4.467	4.02	3.216	2.68	2.297	2.01	1.787	1.608	1.462	1.34

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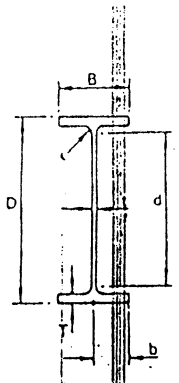
Table 6. Design strengths, p_y, for steel to BS 4360		
BS 4360 Grade	Thickness, T less than or equal to	Sections, plates and hollow sections p_y
	mm	N/mm²
43	16	275
	40	265
	63	255
	100	245
50	16	355
	40	345
	63	340
	100	325
55	16	450
	25	430
	40	415
	63	400

Table 4.4 Limiting width to thickness ratios (elements which exceed these limits are to be taken as class 4, slender cross-sections) (based on Table 7, BS 5950)

Type of element (all rolled sections)	*Class of section*		
	(1) Plastic	*(2) Compact*	*(3) Semi-compact*
Outstand element of compression flange	$\frac{b}{T} \leq 8.5\,\varepsilon$	$\frac{b}{T} \leq 9.5\,\varepsilon$	$\frac{b}{T} \leq 15\,\varepsilon$
Web with neutral axis at mid-depth	$\frac{d}{t} \leq 79\,\varepsilon$	$\frac{d}{t} \leq 98\,\varepsilon$	$\frac{d}{t} \leq 120\,\varepsilon$
Web subject to compression throughout	$\frac{d}{t} \leq 39\,\varepsilon$	$\frac{d}{t} \leq 39\,\varepsilon$	$\frac{d}{t} \leq 39\,\varepsilon$

Note. $\varepsilon = (275/p_y)^{1/2}$ (4.4)



UNIVERSAL BEAMS
To BS4: Part 1

Designation		DIMENSIONS						PROPERTIES												
				Thickness				Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter	Torsional Index	Warping Constant	Torsional Constant	Area of Section
Serial Size	Mass per Metre	Depth Of Section	Width Of Section	Web	Flange	Root Radius	Depth Between Fillets	Flange	Web	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y					
mm	kg	D mm	B mm	t mm	T mm	r mm	d mm	b/T	d/t	cm^4	cm^4	cm	cm	cm^3	cm^3	cm^3	cm^3	u	x	H dm^6	J cm^4	A cm^2
914x419	388	920.5	420.5	21.5	36.6	24.1	799.1	5.74	37.2	719000	45400	38.1	9.58	15600	2160	17700	3340	0.884	26.7	88.7	1730	494
	343	911.4	418.5	19.4	32.0	24.1	799.1	6.54	41.2	625000	39200	37.8	9.46	13700	1870	15500	2890	0.883	30.1	75.7	1190	437
914x305	289	926.6	307.8	19.6	32.0	19.1	824.5	4.81	42.1	505000	15600	37.0	6.51	10900	1010	12600	1600	0.867	31.9	31.2	929	369
	253	918.5	305.5	17.3	27.9	19.1	824.5	5.47	47.7	437000	13300	36.8	6.42	9510	872	10900	1370	0.866	36.2	26.4	627	323
	224	910.3	304.1	15.9	23.9	19.1	824.5	6.36	51.9	376000	11200	36.3	6.27	8260	738	9520	1160	0.861	41.3	22.0	421	285
	201	903.0	303.4	15.2	20.2	19.1	824.5	7.51	54.2	326000	9430	35.6	6.06	7210	621	8360	983	0.853	46.8	18.4	293	256
838x292	226	850.9	293.8	16.1	26.8	17.8	761.7	5.48	47.3	340000	11400	34.3	6.27	7990	773	9160	1210	0.87	35.0	19.3	514	289
	194	840.7	292.4	14.7	21.7	17.8	761.7	6.74	51.8	279000	9070	33.6	6.06	6650	620	7650	974	0.862	41.6	15.2	307	247
	176	834.9	291.6	14.0	18.8	17.8	761.7	7.76	54.4	246000	7790	33.1	5.90	5890	534	6810	842	0.856	46.5	13.0	222	224
762x267	197	769.6	268.0	15.6	25.4	16.5	685.8	5.28	44.0	240000	8170	30.9	5.71	6230	610	7170	959	0.869	33.2	11.3	405	251
	173	762.0	266.7	14.3	21.6	16.5	685.8	6.17	48.0	205000	6850	30.5	5.57	5390	513	6200	807	0.864	38.1	9.38	267	220
	147	753.9	265.3	12.9	17.5	16.5	685.8	7.58	53.2	169000	5470	30.0	5.39	4480	412	5170	649	0.857	45.1	7.41	161	188
686x254	170	692.9	255.8	14.5	23.7	15.2	615.1	5.40	42.4	170000	6620	28.0	5.53	4910	518	5620	810	0.872	31.8	7.41	307	217
	152	687.6	254.5	13.2	21.0	15.2	615.1	6.06	46.6	150000	5780	27.8	5.46	4370	454	5000	710	0.871	35.5	6.42	219	194
	140	683.5	253.7	12.4	19.0	15.2	615.1	6.68	49.6	136000	5180	27.6	5.38	3990	408	4560	638	0.868	38.7	5.72	169	179
	125	677.9	253.0	11.7	16.2	15.2	615.1	7.81	52.6	118000	4380	27.2	5.24	3480	346	4000	542	0.862	43.9	4.79	116	160
610x305	238	633.0	311.5	18.6	31.4	16.5	537.2	4.96	28.9	208000	15800	26.1	7.22	6560	1020	7460	1570	0.886	21.1	14.3	788	304
	179	617.5	307.0	14.1	23.6	16.5	537.2	6.50	38.1	152000	11400	25.8	7.08	4910	743	5520	1140	0.886	27.5	10.1	341	228
	149	609.6	304.8	11.9	19.7	16.5	537.2	7.74	45.1	125000	9300	25.6	6.99	4090	610	4570	937	0.886	32.5	8.09	200	190
610x229	140	617.0	230.1	13.1	22.1	12.7	547.3	5.21	41.8	112000	4510	25.0	5.03	3630	392	4150	612	0.875	30.5	3.99	217	178
	125	611.9	229.0	11.9	19.6	12.7	547.3	5.84	46.0	98600	3930	24.9	4.96	3220	344	3680	536	0.873	34.0	3.45	155	160
	113	607.3	228.2	11.2	17.3	12.7	547.3	6.60	48.9	87400	3440	24.6	4.88	2880	301	3290	470	0.87	37.9	2.99	112	144
	101	602.2	227.6	10.6	14.8	12.7	547.3	7.69	51.6	75700	2910	24.2	4.75	2510	256	2880	400	0.863	43.0	2.51	77.2	129
533x210	122	544.6	211.9	12.8	21.3	12.7	476.5	4.97	37.2	76200	3390	22.1	4.67	2800	320	3200	501	0.876	27.6	2.32	180	156
	109	539.5	210.7	11.6	18.8	12.7	476.5	5.60	41.1	66700	2940	21.9	4.60	2470	279	2820	435	0.875	30.9	1.99	126	139
	101	536.7	210.1	10.9	17.4	12.7	476.5	6.04	43.7	61700	2690	21.8	4.56	2300	257	2620	400	0.874	33.1	1.82	102	129
	92	533.1	209.3	10.2	15.6	12.7	476.5	6.71	46.7	55400	2390	21.7	4.51	2080	229	2370	356	0.872	36.4	1.60	76.2	118
	82	528.3	208.7	9.6	13.2	12.7	476.5	7.91	49.6	47500	2010	21.3	4.38	1800	192	2060	300	0.865	41.6	1.33	51.3	104
457x191	98	467.4	192.8	11.4	19.6	10.2	407.9	4.92	35.8	45700	2340	19.1	4.33	1960	243	2230	378	0.88	25.8	1.17	121	125
	89	463.6	192.0	10.6	17.7	10.2	407.9	5.42	38.5	41000	2090	19.0	4.28	1770	217	2010	338	0.879	28.3	1.04	90.5	114
	82	460.2	191.3	9.9	16.0	10.2	407.9	5.98	41.2	37100	1870	18.8	4.23	1610	196	1830	304	0.877	30.9	0.923	69.2	105
	74	457.2		9.1	14.5	10.2	407.9	6.60	44.8	33400	1670	18.7	4.19	1460	175	1660	272	0.876	33.9	0.819	52.0	95.0
					12.7	10.2	407.9	7.48	48.0	29400	1450	18.5	4.12	1300	153	1470	237	0.873				

UNIVERSAL BEAMS

BS 449

DIMENSIONS

PROPERTIES

Designation		Depth Of Section	Width Of Section	Thickness		Root Radius	Depth Between Fillets	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter	Torsional Index	Warping Constant	Torsional Constant	Area of Section
Serial Size	Mass Per Metre			Web	Flange			Flange	Web	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y					
mm	kg	D mm	B mm	t mm	T mm	r mm	d mm	b/T	d/t	cm^4	cm^4	cm	cm	cm^3	cm^3	cm^3	cm^3	u	x	H dm^6	J cm^4	A cm^2
457x152	82	465.1	153.5	10.7	18.9	10.2	407.0	4.06	38.0	36200	1140	18.6	3.31	1560	149	1800	235	0.872	27.3	0.569	89.3	104
	74	461.3	152.7	9.9	17.0	10.2	407.0	4.49	41.1	32400	1010	18.5	3.26	1410	133	1620	209	0.87	30.0	0.499	66.6	95.0
	67	457.2	151.9	9.1	15.0	10.2	407.0	5.06	44.7	28600	878	18.3	3.21	1250	116	1440	182	0.867	33.6	0.429	47.5	85.4
	60	454.7	152.9	8.0	13.3	10.2	407.7	5.75	51.0	25500	794	18.3	3.23	1120	104	1280	163	0.869	37.5	0.387	33.6	75.9
	52	449.8	152.4	7.6	10.9	10.2	407.7	6.99	53.6	21300	645	17.9	3.11	949	84.6	1090	133	0.859	43.9	0.311	21.3	66.5
406x178	74	412.8	179.7	9.7	16.0	10.2	360.5	5.62	37.2	27300	1540	17.0	4.03	1320	172	1500	267	0.881	27.6	0.608	63.0	95.0
	67	409.4	178.8	8.8	14.3	10.2	360.5	6.25	41.0	24300	1360	16.9	4.00	1190	153	1350	237	0.88	30.5	0.533	46.0	85.5
	60	406.4	177.8	7.8	12.8	10.2	360.5	6.95	46.2	21500	1200	16.8	3.97	1060	135	1190	208	0.88	33.9	0.464	32.9	76.0
	54	402.6	177.6	7.6	10.9	10.2	360.5	8.15	47.4	19600	1020	16.5	3.85	925	114	1050	177	0.872	38.5	0.39	22.7	68.4
406x140	46	402.3	142.4	6.9	11.2	10.2	359.7	6.36	52.1	15600	539	16.3	3.02	778	75.7	888	118	0.87	38.8	0.206	19.2	59.0
	39	397.3	141.8	6.3	8.6	10.2	359.7	8.24	57.1	12500	411	15.9	2.89	627	58.0	721	91.1	0.859	47.4	0.155	10.6	49.4
356x171	67	364.0	173.2	9.1	15.7	10.2	312.3	5.52	34.3	19500	1360	15.1	3.99	1070	157	1210	243	0.887	24.4	0.413	55.5	85.4
	57	358.6	172.1	8.0	13.0	10.2	312.3	6.62	39.0	16100	1110	14.9	3.92	896	129	1010	199	0.884	28.9	0.331	33.1	72.2
	51	355.6	171.5	7.3	11.5	10.2	312.3	7.46	42.8	14200	968	14.8	3.87	796	113	895	174	0.882	32.2	0.286	23.6	64.6
	45	352.0	171.0	6.9	9.7	10.2	312.3	8.81	45.3	12100	812	14.6	3.78	687	95.0	774	147	0.875	36.9	0.238	15.7	57.0
356x127	39	352.8	126.0	6.5	10.7	10.2	311.2	5.89	47.9	10100	357	14.3	2.69	572	56.6	654	88.7	0.872	35.3	0.104	14.9	49.4
	33	348.5	125.4	5.9	8.5	10.2	311.2	7.38	52.7	8200	280	14.0	2.59	471	44.7	540	70.2	0.864	42.2	0.081	8.68	41.8
305x165	54	310.9	166.8	7.7	13.7	8.9	265.7	6.08	34.5	11700	1060	13.1	3.94	753	127	845	195	0.89	23.7	0.234	34.5	68.4
	46	307.1	165.7	6.7	11.8	8.9	265.7	7.02	39.7	9950	897	13.0	3.90	648	108	723	166	0.89	27.2	0.196	22.3	58.9
	40	303.8	165.1	6.1	10.2	8.9	265.7	8.09	43.6	8500	763	12.9	3.85	561	92.4	624	141	0.888	31.1	0.164	14.7	51.5
305x127	48	310.4	125.2	8.9	14.0	8.9	264.6	4.47	29.7	9500	460	12.5	2.75	612	73.5	706	116	0.874	23.3	0.101	31.4	60.8
	42	306.6	124.3	8.0	12.1	8.9	264.6	5.14	33.1	8140	389	12.4	2.70	531	62.5	610	98.2	0.872	26.5	0.0842	21.0	53.2
	37	303.8	123.5	7.2	10.7	8.9	264.6	5.77	36.7	7160	337	12.3	2.67	472	54.6	540	85.7	0.871	29.6	0.0724	14.9	47.5
305x102	33	312.7	102.4	6.6	10.8	7.6	275.9	4.74	41.8	5490	193	12.5	2.15	415	37.8	480	59.8	0.866	31.7	0.0441	12.1	41.8
	28	308.9	101.9	6.1	8.9	7.6	275.9	5.72	45.2	5420	157	12.2	2.08	351	30.8	407	48.9	0.858	37.0	0.0353	7.63	36.3
	25	304.8	101.6	5.8	6.8	7.6	275.9	7.47	47.6	4390	120	11.8	1.96	288	23.6	338	38.0	0.844	43.8	0.0266	4.65	31.4
254x146	43	259.6	147.3	7.3	12.7	7.6	218.9	5.80	30.0	6560	677	10.9	3.51	505	92.0	568	141	0.889	21.1	0.103	24.1	55.1
	37	256.0	146.4	6.4	10.9	7.6	218.9	6.72	34.2	5560	571	10.8	3.47	434	78.1	485	120	0.889	24.3	0.0858	15.5	47.5
	31	251.5	146.1	6.1	8.6	7.6	218.9	8.49	35.9	4440	449	10.5	3.35	353	61.5	396	94.5	0.879	29.4	0.0662	8.73	40.0
254x102	28	260.4	102.1	6.4	10.0	7.6	225.1	5.10	35.2	4010	178	10.5	2.22	308	34.9	353	54.8	0.873	27.5	0.0279	9.64	36.2
	25	257.0	101.9	6.1	8.4	7.6	225.1	6.07	36.9	3410	149	10.3	2.14	265	29.0	306	45.8	0.864	31.4	0.0228	6.45	32.2
	22	254.0	101.6	5.8	6.8	7.6	225.1	7.47	38.8	2870	120	10.00	2.05	226	23.6	262	37.5	0.854	35.9	0.0183	4.31	28.4
203x133	30	206.8	133.8	6.3	9.6	7.6	172.3	6.97	27.3	2890	384	8.72	3.18	279	57.4	313	88.1	0.832	21.5	0.0373	10.2	38.0
	25	203.2	133.4	5.8	7.8	7.6	172.3	8.55	29.7	2360	310	8.54	3.10	232	46.4	260	71.4	0.876	25.4	0.0295	6.12	32.3
203x102	23	203.2	101.6	5.2	9.3	7.6	169.4	5.46	32.6	2090	163	8.49	2.37	206	32.1	232	49.5	0.89	22.6	0.0153	6.87	29.0
178x102	19	177.8	101.6	4.7	7.9	7.6	146.8	6.43	31.2	1360	138	7.49	2.39	153	27.2	171	41.9	0.889	22.6	0.00998	4.37	24.2
152x89	16	152.4	88.9	4.6	7.7	7.6	121.8	5.77	26.5	838	90.4	6.40	2.10	110	20.3	124	31.4	0.889	19.5	0.00473	3.61	20.5
127x76	13	127.0	76.2	4.2	7.6	7.6	96.6	5.01	23.0	477	56.2	5.33	1.83	75.1	14.7	85	22.7	0.893	16.2	0.002	2.92	16.8

Kumpulan kekuatan kayu
(Berdasarkan Malaysian Forest Service Trade Leaflet No.38)

KUMPULAN A		KUMPULAN B		KUMPULAN C	KUMPULAN D
Lasak semula jadi	Perlu diawet	Lasak semula jadi	Perlu diawet	Perlu diawet	Perlu diawet
Balau Bitis Chengal Giam Kekatong Keranji	Kandis Kempas Kulim Mata ulat Meransi Mertas Pauh kijang Penaga Punah Tualang	Balau merah Merbau Resak Tembusu	Bekak Berangan Dedali Derun Kapur Kelat Keledang Keruing Kungkur Mempening Mengkulang Merbatu Merawan Merpauh Nyalin Perah Petaling Rengas Sengkuang Simpoh	Bayur Bintangor Durian Gerutu Kasai Kayu Getah Kedondong Kembang semangkok Ketapang Macang Medang Melantai Melunak Mempisang Meranti bakau Meranti kuning Meranti merah muda Meranti merah tua Meranti putih Mersawa Nyatoh Penarahan Perupok Ramin Sentang Sepetir	Ara Damar minyak Geronggang Jelutong Petai Pulai Sesendok Terap Terentang

...15/-

Tegasan dan modulus keanjalan kering* untuk kumpulan kekuatan (N/mm^2) (MS 544 - *Table 3.5*)

Kumpulan	Gred	Lentur	Tegangan selari dengan ira	Mampatan selari dengan ira	Mampatan serenjang dengan ira	Ricih selari dengan ira	Modulus keanjalan	
							Purata	Minimum
A	Asas	25.20	-	22.27	1.93	3.24	14 750	9 650
	Select	20.00	12.00	17.58	1.59	2.28		
	Standard	15.86	9.52	13.79	1.52	1.79		
	Common	12.60	7.56	11.14	1.45	1.45		
B	Asas	19.86	-	16.06	1.24	2.14	11 720	6 550
	Select	15.86	9.52	12.75	1.03	1.52		
	Standard	12.41	7.45	10.00	0.96	1.17		
	Common	9.65	5.79	7.93	0.90	0.90		
C	Asas	14.48	-	11.03	0.76	1.45	9 310	5 510
	Select	11.38	6.83	8.62	0.62	1.03		
	Standard	8.96	5.38	6.89	0.59	0.76		
	Common	7.24	4.34	5.51	0.55	0.62		
D	Asas	9.65	-	8.27	0.62	1.38	6 550	3 100
	Select	7.58	4.55	6.55	0.52	0.97		
	Standard	5.51	3.31	5.17	0.48	0.76		
	Common	4.83	2.90	4.14	0.45	0.62		

Nota: * Kayu yang mempunyai kandungan lembapan lebih daripada 19%.
Tegangan selari dengan ira = 0.6 × nilai tegasan lentur. Ini merupakan pindaan daripada MS 544 yang dibuat oleh penulis (bukan oleh SIRIM) berasaskan *BS 5268: Part 2: 1984.*